



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/710,020	06/14/2004	Min-Lung Huang	10547-US-PA	4019

31561 7590 01/18/2007
JIANQ CHYUN INTELLECTUAL PROPERTY OFFICE
7 FLOOR-1, NO. 100
ROOSEVELT ROAD, SECTION 2
TAIPEI, 100
TAIWAN

EXAMINER

VAN, LUAN V

ART UNIT	PAPER NUMBER
----------	--------------

1753

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/18/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/710,020

Applicant(s)

HUANG ET AL.

Examiner

Luan V. Van

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

Applicant's amendment of November 29, 2006 does not render the application allowable.

Status of Objections and Rejections

All rejections from the previous office action are maintained.

New grounds of rejection under 35 U.S.C. 103(a) are necessitated by the amendments.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bojkov et al. in view of Chung et al. and Jao.

Regarding claim 1, Bojkov et al. teach a process for fabricating bumps, comprising the steps of: providing a semiconductor substrate having a plurality of bonding pads 30 (Fig. 2) and a passivation layer 42 thereon, wherein the passivation layer is disposed on a surface of the semiconductor substrate and exposes the bonding pads; forming a photoresist layer 46 over the semiconductor substrate, wherein the photoresist layer has a plurality of openings and the openings are positioned corresponding to the bonding pads; immersing the substrate into an electrolytic solution (paragraph 14); and performing an electroplating operation by providing a step current to the electrolytic solution (paragraphs 14-15).

Bojkov et al. differ from the instant claim in that the reference teaches a semiconductor substrate but does not explicitly teach the substrate is in the form of a wafer. Bojkov et al. also differ from the instant claim in that the reference does not explicitly teach the openings having different widths or increasing the current.

Chung et al. teach a method and apparatus are provided for the electroplating of a substrate such as a semiconductor wafer which provides a uniform electroplated surface and minimizes burn-through of a seed layer used on the substrate to initiate electroplating. In one aspect of the invention, a current is applied to the anode and cathode substrate which current is preprogrammed to ramp up to a current value from a first current value which current produces a voltage below a predetermined threshold voltage. Electroplated articles including copper electroplated semiconductor wafers

made using the apparatus and method of the invention are also provided. (See Abstract, and Fig. 4).

Jao teaches a method of forming bumps having a plurality of openings with various sizes (column 2 lines 38-42).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Bojkov et al. by electroplating the wafer of Chung et al., because a semiconductor substrate is conventionally made in the form of a wafer, and a wafer would be suited for the fabrication of integrated circuit devices. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have further modified the method of Bojkov et al. by increasing the current step as taught by Chung et al., because it would provide a uniform electrodeposited material and would minimize burn-through of a seed layer on the substrate (column 1 lines 46-67 of Chung et al.) It would have been obvious to one having ordinary skill in the art at the time the invention was made to have further modified the method of Bojkov et al. by electroplating the openings with various sizes of Jao, because different sizes of solder bumps can be electroplated to meet the specific input/output characteristics of an integrated circuit device.

Regarding claim 2, the instant disclosure does not teach how the minimum current and the maximum current are determined nor the specific values or ranges of values associated with the minimum current and the maximum current. Based on the instant disclosure, the minimum current is broadly interpreted be any arbitrary current below the lowest starting current, and the maximum current can be any arbitrary current

above the highest electroplating current. The step current of Bojkov et al. is between a minimum current, since the current is greater than zero, and below a maximum current, since the current does not go to infinity. Bojkov et al. differ from the instant claim in that the reference does not explicitly teach increasing the current. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Bojkov et al. by increasing the current step as taught by Chung et al., because it would provide a uniform electrodeposited material and would minimize burn-through of a seed layer on the substrate (column 1 lines 46-67 of Chung et al.)

Regarding claim 3, Bojkov et al. teach a plurality of linear currents (see Fig. 5). Linear currents are broadly interpreted to be rectangular current waveforms.

Regarding claim 4, Bojkov et al. teach stopping the current for a brief period (paragraph 5-6).

Regarding claim 5, Bojkov et al. teach the current step comprises a plurality of pulse currents (Fig. 4), each having a peak current 120 and a trough current 122.

Regarding claim 6, Bojkov et al. teach the peak current is between a minimum current, since the current is greater than zero, and a maximum current, since the current does not go to infinity.

Regarding claim 7, Bojkov et al. teach the trough current 120 is a negative current. The representation of the current polarity of Bojkov et al. is the reverse of the instant the invention, because the polarity is viewed from the perspective of the power

supply. The current polarity would be reversed if viewed from the perspective of the substrate.

Regarding claim 8, Bojkov et al. teach the current step comprises at least a pulsed current (combination of pulses 120 and 122, Fig. 4) and a plurality of linear currents (pulses 120, Fig. 4).

Regarding claim 9, Bojkov et al. teach the peak current is between a minimum current, since the current is greater than zero, and a maximum current, since the current does not go to infinity.

Regarding claim 10, Bojkov et al. teach the trough current 120 is a negative current.

Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bojkov et al. in view of Chung et al., Jao, and further in view of Ihara et al.

Bojkov et al., Chung et al., and Jao teach the method as described above. Bojkov et al. differ from the instant claims in that the reference does not explicitly teach the aspect ratio of the instant claim.

Ihara et al. teach a method of forming bumps wherein the thickness of the resist layer and the diameter of the fine hole are adjusted so that the aspect ratio (height/diameter) of a bump to be formed can be a value not lower than 0.5. Since air can escape smoothly even if the aspect ratio of the bump is not lower than 0.5 or especially even if the aspect ratio of the bump is not lower than 1, plating can be positively carried out in the fine holes. (Column 6 lines 67 -- column 7 line 6).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Bojkov et al., Chung et al., and Jao by using the aspect ratio of Ihara et al., because air can escape smoothly (column 6 lines 67 -- column 7 line 6 of Ihara et al.).

Response to Arguments

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). The examiner acknowledges that Bojkov et al. fail to disclose different width openings. However, as described above, Jao teaches a method of forming bumps having a plurality of openings with various sizes (column 2 lines 38-42). It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Bojkov et al. by electroplating the openings with various sizes of Jao, because different sizes of solder bumps can be electroplated to meet the specific input/output characteristics of an integrated circuit device.

In response to applicant's argument that the references fail to show certain features of applicant's invention (in independent claim 1), it is noted that the features upon which applicant relies (i.e., high aspect ratio of openings) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification,

limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Applicant's arguments have been fully considered but they are not persuasive.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).


A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 9:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LVV
January 9, 2007



NAM NGUYEN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700